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OBSERVATIONS *on* RAIN GAGES.

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THE theory of rain has long engaged the attention of philoſophers, and many ingenious and plauſible conjectures on the nature of this meteor have been given to the public; but the facts of which we are at preſent poſſeſſed ſeem to me to be too few in number, and to have been made at places too remote from each other, either to refute or confirm the theories in queſtion. This conſideration induced me to collect all the obſervations on this ſubject I could; and in the laſt volume of the Memoirs of the Literary and Philoſophical Society of Mancheſter is an Eſſay of mine containing a number of obſervations made on the weſtern coaſt of this iſland. Since the publication of that Memoir I have received journals from different parts of the kingdom,

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kingdom, and have prevailed on ſeveral of my philoſophical friends in different counties to keep exact regiſters of the barometer, thermometer and rain gage. By theſe means I am induced to hope that we ſhall be furniſhed with a part of the natural hiſtory of this iſland as yet little known, and which will not merely be gratifying to curioſity, but applicable to the moſt uſeful purpoſes, and which promiſes to ſupply the deficiency of obſervation, and enable the philoſopher to correct his theory by facts.

THE barometer and thermometer are inſtruments which are liable to little error when carefully made and in the moſt ſimple form; but rain gages are very imperfect inſtruments. My attention was directed to the methods of remedying their imperfections as much as poſſible, from having obſerved that the journals of two gentlemen at Kendal in Weſtmoreland, whoſe accuracy in obſervation could not be ſuſpected, differed conſiderably, though their gages were ſimilarly expoſed, but I do not know whether ſimilar in their conſtruction.

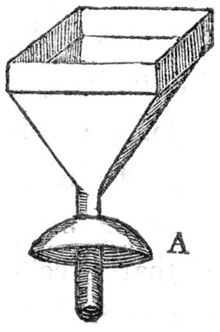
RAIN GAGES are imperfect on two accounts. Firſt, on account of the evaporation which very commonly takes place on the interior ſurface of the funnel during wet weather in ſummer; for the air is for the moſt part in a condition to abſorb more water than it contains, though our humid atmoſphere is ſometimes ſo perfectly ſaturated as to depoſite part of its vapours on furniture within doors, even during the months of July and Auguſt, provided the weather be very wet; but water will frequently evaporate from the ſurfaces of many bodies, particularly from

from metallic ſubſtances, as I have found by experiment, while rain is falling in ſummer, or dew forming in an evening; for if a veſſel of tinned iron be rubbed over with a wet ſpunge, and then ſuſpended with its mouth downwards, its inner ſurface will ſoon become dry again, though rain be falling or dew forming at the time.

As this evaporation cannot be entirely prevented by any method of conſtructing the gage, if the quantity of water loſt this way could be determined, this imperfection would be corrected; and I ſhould think that this quantity might be determined by two contiguous gages. For, let A and a = the areas of the apertures of the two gages; B and b = the curve ſurfaces of the funnels; S, s = the quantities of water collected by them in a given time in grains; X and x the quantities loſt by evaporation in the ſame time; then $S + X$ and $s + x$, being the quantities received by the gages, we have $A : a :: S + X : s + x$, and $x = \frac{aS - As + aX}{A}$; but ſince the quantities evaporated in the ſame time are as thoſe ſurfaces, $B : b :: X : x$, and $x = \frac{bX}{B} = \frac{aS - As + aX}{A}$; hence $X = \frac{BaS - BAs}{Ab - Ba}$, and the quantity corrected $= S + X = \frac{AbS - BAs}{Ab - Ba}$; but the cones muſt not be ſimilar, for in that caſe both the numerator and denominator would be $= 0$, and conſequently nothing could be determined. Indeed, if it was worth the while, it might even be determined in this caſe, by taking the fluxion of the quantity.

The ſecond imperfection ariſes from the loſs of water occaſioned by drops of rain burſting when they are driven obliquely by a breeze, and ſtrike the ſides of the gage: in ſuch caſes they diſperſe into a number of minute drops, many of which never deſcend into the receiver, but eſcape over the margin of the funnel. This depends on principles too ſimple to require any experimental proof It is difficult, if not impoſſible, to prevent entirely this loſs of water by diſperſion; all that we can do is to diminiſh the cauſe of it as much as we can. An ingenious friend of mine, Mr. Gough of Kendal, in a letter which I lately received from him, propoſes the following method of remedying this imperfection.

A linen ſtrainer, he ſays, of a conical figure, ſhould be fitted exactly to the mouth of the gage; this flexible funnel ſhould be ſtretched by a weight or ſtring fixed to its apex within the veſſel; the drops ſtriking on this yielding ſubſtance would receive a moderate concuſſion, and the particles of water would be entangled in the threads of the cloth. It is evident that this would greatly prevent the loſs occaſioned by diſperſion, but would much increaſe the evaporation, by detaining a quantity of water in the funnel, expoſing a much greater ſurface to the air. A better way of remedying this imperfection is to have a perpendicular rim, an inch or two high, fixed to the rim of the funnel. I have here given the form of rain-gages which I have had conſtructed for my friends.



In gages of this form, eſpecially when made ſufficiently large, Mr. Copland of Dumfries informs me that he found the loſs from diſperſion nearly, if not entirely, corrected. The area of the aperture of one of his funnels contains 144 ſquare inches, and the other 288. He has compared this with one of 16 inches, and always found a ſmaller than proportional reſult from this laſt in windy weather. He ſays he has obſerved his large ſquare gages in ſtormy falls, and could obſerve nothing driven over after it had ſtruck the inſide, and was ſurpriſed to ſee ſo little loſt even during a hail ſhower. He recommends gages with ſquare apertures in preference to circular or cylindrical, for “ from the rotatory motion which the air always takes, when forced over the end of a tranſverſely truncated cylinder, and which emits, for that reaſon, a whiſtling noiſe, the rain will be carried over the edges of the cylinder, and be almoſt entirely prevented from falling into the gage.” He ſoon found, after uſing ſquare ones, that the reſults from them were much more ample than from ſome others that were kept in the neighbourhood, which were of a cylindrical form. I generally have a little cup with its mouth downwards, fitted to the neck of the funnel as at A, which will go over the mouth of the bottle; becauſe it is evident that when rain is driven againſt the outſide of the funnel, or in conſequence of the condenſation of dew upon the outer or under ſide of it, more water would be collected by the receiver than falls within the area of the funnel, if it was not prevented by a contrivance of this kind.

I WAS induced to trouble the Academy with the preceding obſervations, in hopes that they might direct the attention of philoſophers in our ſiſter kingdom to this ſubject; for this part of the natural hiſtory of Ireland is yet very imperfectly known; but I am happy to find it has engaged the attention of that excellent philoſopher Mr. Kirwan, by whom it may be expected that much light will be thrown on it. If theſe hints ſhould meet with a favourable reception, I intend from time to time to ſend to the Academy an account of any philoſophical diſcoveries or obſervations that may occur to me.

I HAVE ſubjoined a table containing the quantity of rain in inches and parts which has fallen within five years; the places of obſervation were chiefly on the weſtern coaſt of this iſland, and may eaſily be compared with the quantities which fall on correſponding parts of the eaſtern coaſt of Ireland.

Years	Dumfries.	Kendal.	Keſwick.	Fellfoot.	Lancaſter.	Salford.	Youngſbury.	London.
1788	26,423	39,2575	34,3057	42,06	29,45		17,676	14,892
1789	48,093	69,835	72,2449	66,52	51,01		29,493	21,976
1790	39,354	66,263	64,7439	58,48	46,61	42,75	22,970	16,052
1791	39,2817	62,200	73,5522				24,200	
1792	47,5130	84,884	84,6051			54,75		19,5

N. B.

N. B. Kendal bears N. 30°. W. from London, diſtant 226 Engliſh miles, meaſured on a great circle of the earth; and, according to the obſervations of Mr. Dalton, the town is elevated about 46 yards above the level of the ſea. Keſwick bears N. 30°. W. from Kendal, 22 Engliſh miles, meaſured on a great circle; and, according to Mr. Croſthwaite, is elevated about 76 yards above the level of the ſea.

FELLFOOT lies at the ſouth end of Winandermere, where the lake contracts into a river, and is about 26 yards above the level of the ſea. Theſe places are ſurrounded with high hills, ſome of them elevated conſiderably more than a thouſand yards above the level of the ſea. Salford joins Mancheſter, and Youngſbury is near Ware in Hertfordſhire, 20 miles north of London.

THE difference in the quantities of rain which fall at theſe different places is ſurprizing. Much more falls in hilly than in level countries.

T. GARNETT.

Harrogate, December 10, 1793.